

A Fossorial Lizard with Forelimbs Only: Description of a New Genus and Species of Malagasy Skink (Reptilia: Squamata: Scincidae)

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Abstract: A new genus and species of fossorial scincine lizard is described from northeastern Madagascar. This species, having an elongated body and eyes covered by scales, lacking external ear openings and pigmentation throughout the body, resembles *Cryptoscincus* and *Voeltzkowia*. However it differs from these or any other scincid genera known to the present in having small but distinct forelimbs, each with four stout claws, and complete lack of hind limbs.

Key words: New genus; New species; Scincidae; Madagascar; Fossorial; Limb reduction

INTRODUCTION

Seven endemic genera of the subfamily Scincinae (Squamata, Scincidae) are known from Madagascar, and most of them consist of fossorial or semifossorial species (Angel, 1924; Brygoo, 1979, 1980a–d, 1981a–c, 1984a–d, 1985; Mocquad, 1909). Recent herpetological surveys on Madagascar led to discoveries of many new species (Raxworthy and Nussbaum, 1993; Nussbaum and Raxworthy, 1995; Andreone and Greer, 2002; Sakata and Hikida, 2003). Due to their largely secretive habits, however, many species of these and related genera are thought to remain undiscovered.

Ecological surveys, carried out by Japanese ornithologists and herpetologists in collaboration with their Malagasy counterparts in

Ampijoroa, Ankafantsika Strict Nature Reserve, northwestern Madagascar (Fig. 1), yielded two specimens of an apparently undescribed skink. This skink differs from any known scincids in having forelimbs only. We thus describe it as a new genus and species.

MATERIALS AND METHODS

The specimen was fixed with 10% formalin, preserved in 75% ethanol, and deposited in the Zoological Collection of the Kyoto University Museum (KUZ). The following measurements were taken with dial calipers and recorded to the nearest 0.1 mm: snout-vent length (SVL), tail length, head length (snout tip to posterior margin of parietals), snout length (snout tip to anterior corner of eye), head width (the widest point of temporal region), and midbody width. Vertebral characters were determined by radiographs (Softex M-60, Softex Co.).

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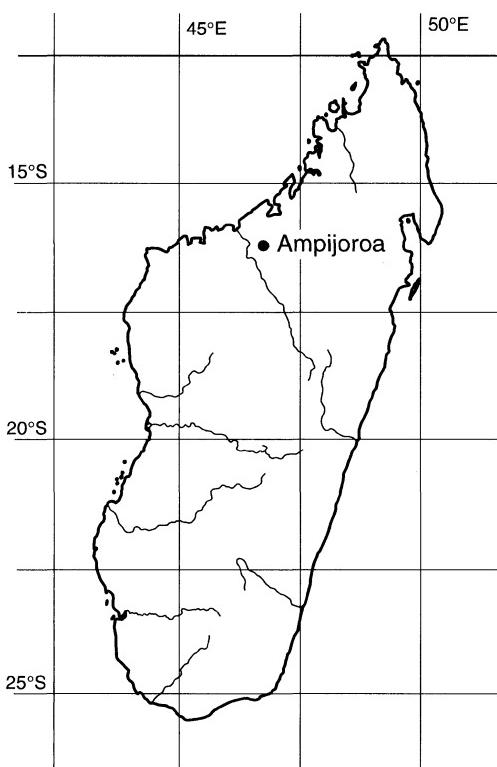


FIG. 1. Map of Madagascar, showing location of Ampijoroa, the type locality of *Sirenoscincus yamagishii* sp. nov.

We defined the scales covering the eyes as ocular(s). Terminology for the other characters follows Sakata and Hikida (2003).

Sirenoscincus yamagishii gen. et sp. nov.
Figs. 2 and 3

Holotype

KUZ R50922, mature female; Ampijoroa, Ankarafantsika Strict Nature Reserve, northwestern Madagascar (16°20'S, 46°48'E; Fig. 1), 100 m; collected by A. Mori, M. Hasegawa, and I. Ikeuchi, 7 November 1999.

Paratype

KUZ R50823, mature female, from the same locality as the holotype, collected by G. Razafindrakoto, as a "dead on the road" specimen, 11 November 1999.

Generic diagnosis

The new genus is a member of the subfamily Scincinae (Greer, 1970). It is distinguished from all other taxa in this group by the following combination of characters in derived states (polarity for each of these characters was inferred as relative to *Eumeces*, the putative primitive genus of the family: Greer and Broadley, 2000). Body highly elongated (SVL 11.6–14.0 times head length) with 53 presacral vertebrae; original tail slightly longer than SVL; snout pointed, lower jaw countersunk; neck indistinguishable externally; body scales smooth and transparent without pigmentation; 20 longitudinal scale rows at mid-body. Forelimb small (approximately 4.7% of SVL) with indistinct fingers and four stout claws; no hind limbs, shallow groove in their position in other scincines; prefrontals absent; nasal sharply pointed, triangular, positioned at V-shaped notch of rostral; nostril positioned at anterior tip of nasal; frontonasal as large as frontal; frontoparietal absent; loreal single; supraoculars two; superciliaries and movable lower eyelid absent; eye covered with two oculars; supralabials six; infralabials five, anterior three higher than posterior two; external ear opening covered by scales, but small ear groove visible through transparent scale; postmental single.

Species diagnosis

The species diagnosis is the same as that for the genus.

Description of holotype

Adult female. Head much narrower than body; snout pointed; lower jaw countersunk; nostril anterolaterally oriented, visible from above; ear openings absent, small ear groove visible through transparent scales covering it; neck not distinct; body greatly elongated, with 53 presacral vertebrae; body and tail round in cross section; forelimbs small, with indistinct fingers and four stout claws; hind limbs absent.

Rostral scale large, overlapping nasals, supranasals and first supralabials; nasal sharply pointed and triangular, positioned in

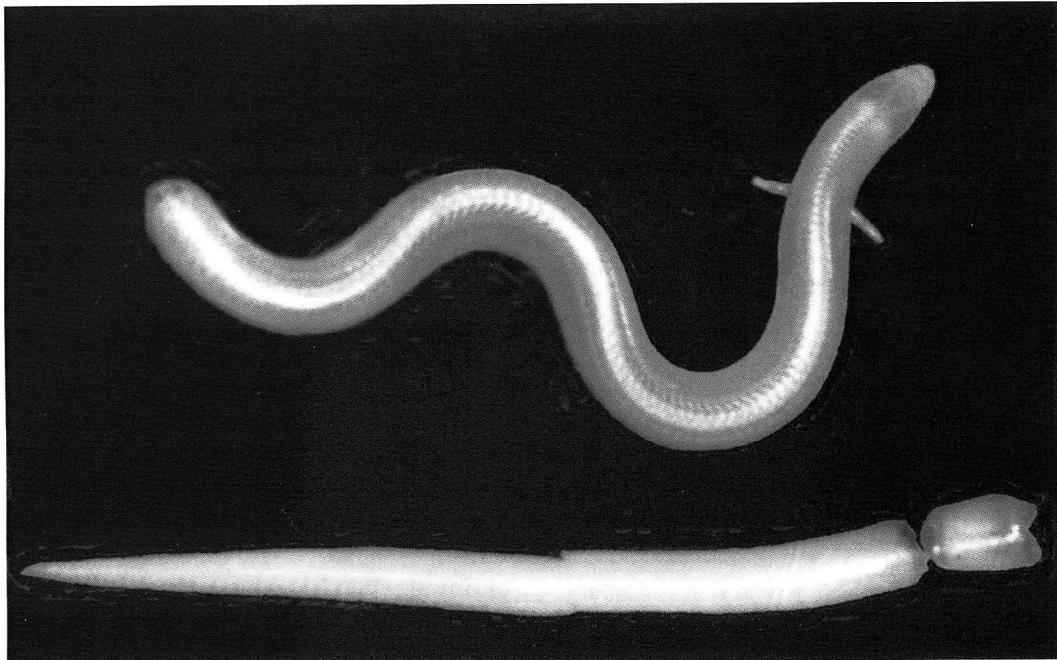


FIG. 2. Holotype of *Sirenoscincus yamagishii* sp. nov. (KUZ R50922) in life, with its autotomized tail.

the V-shaped notch of rostral, overlapping supranasal and first supralabial; nostril located in anterior tip of nasal, in contact with rostral; supranasals two, each overlapped by first supralabial, overlapping loreal and frontonasal, right overlapping left; frontonasal overlapped laterally by loreal, overlapping frontal and first supraocular posteriorly; prefrontals absent; frontal as large as frontonasal, overlapped laterally by first supraocular, overlapping interparietal and a pair of parietals posteriorly; frontoparietal absent; interparietal triangular, with two longer sides converging to a bluntly rounded apex posteriorly, overlapping parietals; transparent spot on interparietal absent; parietals two large, quadrangular, left overlapping right behind interparietal, each overlapped by first and second supraoculars, overlapping upper secondary temporal and first nuchals; two nuchals on left, one on right; supralabials six, three preorbital, one subocular and two postorbital; loreal single, quadrangular, as long as second supralabial, overlapped below by first and second supralabials, overlapping first supraocular and

preocular posteriorly; preocular single, overlapped by second supralabial, overlapping first supraocular, first ocular, and third supralabial; presubocular absent; supraoculars two, overlapped by two oculars below, overlapping frontal and parietal above, and primary and upper secondary temporals posteriorly; oculars two, covering eye, overlapped by third supralabial, overlapping supraoculars, primary temporal and fourth supralabial; postsubocular absent; primary temporal one, overlapped by fourth supralabial, overlapping upper and lower secondary temporals and fifth supralabial; upper secondary temporal about half as long as parietal, overlapping lower secondary temporal, nuchal, and anteriormost scale of a lateral body scale row; lower secondary temporal overlapped by fifth supralabial, overlapping sixth supralabial and anteriormost scales belonging to lateral body scale rows; mental slightly larger than postmental, overlapping postmental and first infralabials; postmental overlapped by first infralabials, overlapping the first pair of chin shields; three pair of chin shields, first pair in contact, second separated

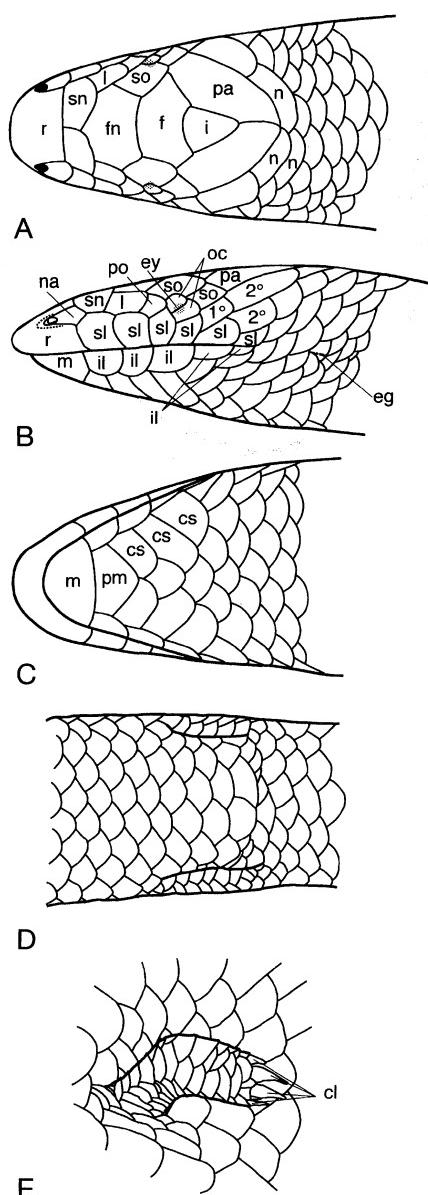


FIG. 3. Dorsal (A), lateral (B) and ventral (C) views of head, ventral view of cloacal region (D), and left forelimb (E) of the holotype of *Sirenoscinus yamagishii* sp. nov. (KUZ R50922). Abbreviations are: 1°, primary temporal; 2°, secondary temporal; cl, claw; cs, chinshield; eg, ear groove; ey, eye; f, frontal; fn, frontonasal; i, interparietal; il, infralabial; l, loreal; m, mental; n, nuchal; na, nasal; pa, parietal; pm, postmental; po, preocular; oc, ocular; r, rostral; sl, supralabial; sn, supranastral; so, supraocular.

by one scale, and third separated by three scales; five infralabials, second highest, third widest; body and tail covered with smooth cycloid scales; position of hind limb insertion in other scincines having a patch of small scales, followed by short groove; preanal scales two, slightly larger than ventral body scales, right overlapping left; tail broken when captured.

Measurements of holotype (mm)

SVL, 82.5; original tail length, 84.4; head length, 7.1; snout length, 4.0; head width, 4.2; midbody width, 5.2; length of forelimb exclusive of claws, 3.8; fourth finger length, 0.6; distance between nostrils, 1.8.

Coloration

In life, head, body, forelimbs and tail uniformly pinkish white; snout somewhat paler than the other portion of head; black pigmentation of eye visible; autotomized tail somewhat whiter than original portion; scales transparent, without pigmentation; claws white. After preservation, pinkish coloration faded to uniformly white, and then to slightly yellowish after half year in alcohol.

Variation

In paratype, head slightly depressed; forelimb broken; SVL, 86.9; tail length, 53.7; head length, 6.20; snout length, 3.0; head width, 5.4; midbody width, 4.6; distance between nostrils, 1.7. This specimen had more nuchals than holotype—two in left, three in right.

Etymology

The generic name is derived from the Latin words, *siren* (mermaid) and *scincus* (skink), referring to the unique body shape of the type species with forelimbs only. The specific epithet is dedicated to Dr. Satoshi Yamagishi, who was a professor of Kyoto University and the project leader of Ecological Surveys in Ampijoroa, Ankafantsika Strict Nature Reserve, in which both of the type specimens were obtained.

Natural history

The holotype was found under the leaf litter during a night survey. The collectors first found an autotomized tail which was still moving on the leaf litter. Then they searched around there and captured the holotype. The paratype was collected as a dead body on the road. Additionally three tails obviously belonging to the present species were obtained as stomach contents of two colubrid snakes, *Liophidium torquatum* and *Dromicodryas bernieri*. These two snake species are considered to be terrestrial (Mori et al, unpublished observation). Probably *Sirenoscincus yamagishii* is a common prey item for such terrestrial snakes around the type locality.

DISCUSSION

All Malagasy scincine lizards known to the present are fossorial or semifossorial except for three aquatic or semi-aquatic species of

the genus *Amphiglossus*; *A. astrolabi*, *A. reticulatus*, and *A. waterloti* (Brygoo, 1979, 1980a-d, 1981a-c, 1984a-d, 1985, Raxworthy and nussbaum, 1993), showing various degrees of reduction of limbs (from partial reduction of digits on forelimb or hind limb to the complete loss of both limbs), eyes, and ear-openings (Table 1). Among the eight genera, *Amphiglossus* seems to be most primitive in that it usually has four pentadactyl limbs, movable eyelids, and external ear openings. Three genera, *Voeltzkowia*, *Cryptoscincus*, and *Sirenoscincus*, are obviously extremely adapted to fossorial life in that their bodies are elongated, and eyes and ear openings are covered by scales. Pigmentation in scales is also lost in all the species of these genera except for three species of *Voeltzkowia*.

Two species of *Voeltzkowia*, formerly assigned to the subgenus *Grandidiernina*, have no forelimbs and reduced hind limbs. The other three species of *Voeltzkowia* and a species of

TABLE 1. Comparisons of the Malagasy scincine genera. Numerals indicate numbers of digits on forelimbs and hind limbs. Symbols: +, present; -, absent; bt, button-like scale; nb, nub; st, styliform.

Genus/Species	Number of species	Eyes	Ear openings	Forelimbs	Hind limbs
<i>Amphiglossus</i>					
<i>A. stylus</i>	1	+	-	nb	st
<i>A. crenni</i>	1	+	+	2-3	2-4
other species	32	+	+	5	5
<i>Androngo</i>	1	+	+	2-5	2-5
<i>Paracontias</i>	8	+	-	-	-
<i>Pseudoacontias</i>					
<i>P. angelorum</i>	1	+	-	-	st
<i>P. menamainty</i>	1	+	-	bt	-
other species	2	+	-	-	-
<i>Pygomeles</i>					
<i>P. braconnieri</i>	1	+	+	-	st
<i>P. petteri</i>	1	+	-	-	-
<i>Voeltzkowia</i>					
<i>V. fierinensis</i>	1	-	-	-	2
<i>V. petitii</i>	1	-	-	-	st
other species	3	-	-	-	-
<i>Cryptoscincus</i>	1	-	-	-	-
<i>Sirenoscincus</i>	1	-	-	4	-

the monotypic genus *Cryptoscincus* (*C. minimus*) lack both forelimbs and hind limbs. In contrast, *Sirenoscincus* has tetradactyl forelimbs, but lacks hind limbs. This genus is quite similar to *Voeltzkowia* in a number of scale characters, but different from the latter in the combination of reduced limbs, suggesting its independent derivation from a four-limbed ancestor.

It is generally assumed that in Scincidae the limb loss occurred first in the forelimbs (Gans, 1975). *Sirenoscincus* offers a first obvious exception to these schemes. Another possible exception was exhibited by *Pseudoacontias menamainty*, which, while lacking hind limbs, has rudimentary, button-like traces of forelimbs. The bipedid amphisbaenians also have prominent forelimbs and lack hind limbs. From the shape of forelimbs that resemble those of moles, this group of lizards probably uses the forelimbs for digging. However the function of the forelimbs of *Sirenoscincus* is still unknown, since they seem to be too small for digging. The small but distinct forelimbs in *Sirenoscincus* may have a function for mating.

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LITERATURE CITED

ANDREONE, F. AND A. E. GREER. 2002. Malagasy

scincid lizards: description of nine new species, with notes on the morphology, reproduction and taxonomy of some previously described species (Reptilia, Squamata, Scincidae). *J. Zool. Lond.* 258: 139–184.

ANGEL, F. 1924. Sur une forme nouvelle de Lézard, en provenance de Madagascar, appartenant au genre *Grandidierina* (Famille de Scincidés). *Bull. Mus. natn. Hist. nat. Paris.* 30: 450–452.

BRYGOO, E. R. 1979. Systématique des lézards scincidés de la région malagache. I. *Scelotes trivittatus* (Boulenger, 1896) nov. comb. synonyme de *Scelotes trilineatus* Angel, 1949. *Bull. Mus. natn. Hist. nat. Paris. Sér. 4, 1. sec. A.* 4: 1115–1120.

BRYGOO, E. R. 1980a. Systématique des lézards scincidés de la région malagache. II. *Amphiglossus astrolabi* Dumeril et Bibron, 1839; *Gongylus polleni* Grandidier, 1869; *Gongylus stimpffi* Boettger, 1882, et *Scelotes waterloti* Angel, 1930. *Bull. Mus. natn. Hist. nat. Paris. Sér. 4, 2. sec. A.* 2: 525–539.

BRYGOO, E. R. 1980b. Systématique des lézards scincidés de la région malagache. III. Les "Aconias" de Madagascar: *Pseudoacontias* Barboza du Bocage, 1889, *Paracontias* Mocquard, 1894, *Pseudoacontias* Hewitt, 1929, et *Malacontias* Greer, 1970. *Bull. Mus. natn. Hist. nat. Paris. Sér. 4, 2. sec. A.* 3: 905–918.

BRYGOO, E. R. 1980c. Systématique des lézards scincidés de la région malagache. IV. *Amphiglossus reticulatus* (Kaudern, 1922) nov. comb., troisième espèce du genre; ses rapports avec *Amphiglossus waterloti* (Angel, 1920). *Bull. Mus. natn. Hist. nat. Paris. Sér. 4, 2. sec. A.* 3: 905–918.

BRYGOO, E. R. 1980d. Systématique des lézards scincidés de la région malagache. V. *Scelotes praeornatus* Angel, 1938, synonyme de *Scelotes* s.l. *frontoparietalis* (Boulenger, 1889). *Bull. Mus. natn. Hist. nat. Paris. Sér. 4, 2. sec. A.* 4: 1155–1160.

BRYGOO, E. R. 1981a. Systématique des lézards scincidés de la région malagache. VI. Deux Scincinés nouveaux. *Bull. Mus. natn. Hist. nat. Paris. Sér. 4, 3. sec. A.* 1: 261–268.

BRYGOO, E. R. 1981b. Systématique des lézards scincidés de la région malagache. VII. Révision

- des genres *Voeltzkowia* Boettger, 1893, *Grandierina* Mocquard, 1894, et *Cryptoscincus* Mocquard, 1894. Bull. Mus. natn. Hist. nat. Paris. Sér. 4, 3. sec. A. 2: 675–688.
- BRYGOO, E. R. 1981c. Systématique des lézards scincidés de la région malagache. IX. Nouvelles unités taxinomiques pour les *Scelotes* s.l.. Bull. Mus. natn. Hist. nat. Paris. Sér. 4, 3. sec. A. 4: 1193–1204.
- BRYGOO, E. R. 1984a. Systématique des lézards scincidés de la région malagache. XIII. Les *Amphiglossus* du sous-genre *Madascincus*. Bull. Mus. natn. Hist. nat. Paris. Sér. 4, 6. sec. A. 2: 527–536.
- BRYGOO, E. R. 1984b. Systématique des lézards scincidés de la région malagache. XIV. Les genre *Pygomeles* A. Grandidier, 1867. Bull. Mus. natn. Hist. nat. Paris. Sér. 4, 6. sec. A. 3: 769–777.
- BRYGOO, E. R. 1984c. Systématique des lézards scincidés de la région malagache. XV. *Gongylus igneocaudatus* A. Grandidier, 1867, et *Scelotes intermedius* Boettger, 1913. Les *Amphiglossus* du groupe *igneocaudatus*. Bull. Mus. natn. Hist. nat. Paris. Sér. 4, 6. sec. A. 3: 779–789.
- BRYGOO, E. R. 1984d. Systématique des lézards scincidés de la région malagache. XVI. Les *Amphiglossus* du groupe *ornaticeps*. Bull. Mus. natn. Hist. nat. Paris. Sér. 4, 6. sec. A. 4: 1153–1160.
- BRYGOO, E. R. 1985. Systématique des lézards scincidés de la région malagache. XVII. *Gongylus splendidus* A. Grandidier, 1872, *Scelotes macrolepis* Boulenger, 1888, et *Scelotes decaryi* Angel, 1930. Bull. Mus. natn. Hist. nat. Paris. Sér. 4, 7. sec. A. 1: 235–247.
- GANS, C. 1975. Tetrapod limblessness: evolution and functional corollaries. Amer. Zool. 15: 455–467.
- GREER, A. E. 1970. A subfamilial classification of scincid lizards. Bull. Mus. Comp. Zool. Harvard Univ. 139: 151–184.
- GREER, A. E. AND D. G. BROADLEY. 2000. Six characters of systematic importance in the scincid lizard genus *Mabuya*. Hamadryad. 25: 1–12.
- MOCQUARD, F. 1909. Synopsis des familles, genres et espèces des Reptiles écailleux et des Batraciens de Madagascar. Nouv. Archs Mus. Hist. nat. Paris. sér. 5, 1: 110#p.
- NUSSBAUM, R. A. AND C. J. RAXWORTHY. 1995. Review of the scincine genus *Pseudoacontias* Barboza du Bocage (Reptilia: Squamata: Scincidae) of Madagascar. Herpetologica. 51: 91–99.
- SAKATA, S AND T. HIKIDA. 2003. A new fossorial scincine lizard of the genus *Pseudoacontias* (Reptilia: Squamata: Scincidae) from Nosy Be, Madagascar. Amphibia-Reptilia. 24: 57–64.
- RAXWORTHY, C. J. AND R. A. NUSSBAUM. 1993. Four new species of *Amphiglossus* from Madagascar (Squamata: Scincidae). Herpetologica. 49: 326–341.

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